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WASHINGTON D.C., 20460

OFFICE OF
CHEMICAL SAFETY AND
POLLUTION PREVENTION

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MEMORANDUM

SUBJECT: Aminocyclopyrachlor Triethylamine Salt (INVORA) – Ecological Risk Assessment for the Proposed New Use on Rangeland (EPA Reg. No. 432-1582)

FROM: Brian D. Kiernan, Biologist — BRIAN KIERNAN Digitally signed by BRIAN KIERNAN Date: 2020.01.22 12:21:03 -05'00'
Chuck Peck, Senior Environmental Fate Scientist — 2020.01.22 12:58:34 -05'00'
William P. Eckel, Senior Science Advisor — Digitally signed by William P. Eckel Date: 2020.01.22 13:37:01 -05'00'
Environmental Risk Branch 6
Environmental Fate & Effects Division

THRU: Mark Corbin, Branch Chief — Digitally signed by MARK CORBIN Date: 2020.01.22 12:41:39 -05'00'
Monica Wait, RAPL — Digitally signed by MONICA WAIT Date: 2020.01.22 13:31:57 -05'00'
Environmental Risk Branch 6
Environmental Fate & Effects Division

TO: Margaret Hathaway, Senior Regulatory Specialist
Mindy Ondish, Product Manager Team 23
Daniel Kenny, Branch Chief
Herbicide Branch
Registration Division

This memorandum transmits the Environmental Fate and Effects Division's (EFED) ecological risk assessment for the proposed new use of the herbicide aminocyclopyrachlor (ACP) triethylamine salt (TEA; PC Code 005110) (EPA Reg. No. 432-1582, product tradename INVORA) on private rangeland in four states: Texas, New Mexico, Oklahoma and Arizona. The primary target vegetation for this proposed use are huisache (*Vachellia farnesiana*) and mesquite (*Prosopis* spp.), which left unchecked will encroach on permanent grasslands (successional species) and interfere with the grazing of livestock.

The proposed application rates and application timing are dependent on the primary target species. Huisache is treated in the fall and has a maximum single application rate of 0.25 pounds acid equivalent per acre (lbs a.e./A); mesquite is treated earlier in the season with a single maximum application rate of 0.19 lbs a.e./A. Western honey mesquite (*Prosopis glandulosa* var *torreyana*), like huisache, can be treated at 0.25 lbs a.e./A, although the timing is late summer/early fall. Western honey mesquite may also be treated twice at a rate of 0.14 lbs a.e./A 14 days apart, for a total application rate of 0.28 lbs a.e./A, also in late summer/early fall. Based on the previous environmental risk assessment, potential impacts to nontarget terrestrial plants are the only risks of concern for the proposed use pattern.

Based on EFED's analysis, there is the potential for spray drift and, given the mobility and persistence of ACP, modeling has indicated that there is a potential for runoff from a target area treated at the proposed application rates that can adversely affect surrounding vegetation. These conclusions are supported by numerous incidents associated with ACP use on turf (since cancelled) and rights of way. There are proposed label requirements intended to ensure that ACP does not end up in compost; otherwise there is the potential to adversely affect plants that may be supplemented with ACP-contaminated compost or manure. However, adverse impacts to nontarget plants and their associated ecosystem function are expected.

Previous Risk Assessment Conclusions and New Use Risk Assessment Approach

ACP was first registered for use on non-crop areas and turf in 2010. EFED provided a document entitled "Ecological Risk Assessment for the Section 3 New Chemical Registration of Aminocyclopyrachlor on Non-crop Areas and Turf" (1/22/2010; DP 358167) in support of the registration decision. The turf use was assessed at a maximum single application rate of 0.108 lbs a.e./A, with a maximum of three applications and yearly maximum of 0.324 lbs a.e./A. Non-crop areas were assessed with a single application of 0.284 lbs a.e./A. The assessment identified risks to terrestrial plants and, due to data issues, assumed chronic risk to avian species and aquatic invertebrates. These data issues have since been resolved, and there are no longer presumed to be chronic risks to avian species or aquatic invertebrates.

Based on the conclusions of the previous risk assessment and the subsequent resolution of data gaps, this current assessment focuses solely on risk to terrestrial plants. It should be noted, however, that the dataset for honeybees is incomplete. Although practically non-toxic to adult honeybees based on the available acute contact study (MRID 47560131; 850.3020), EPA's current data requirements include the following Tier 1 data: acute exposure to larval (oral) and adult (contact and oral) honey bees; chronic exposure for both larval and adult honeybees; these data are necessary for a complete risk assessment.

Mechanism of Action

ACP is a systemic herbicide; it remains biologically active in soil and is rapidly absorbed by roots and leaves. It is then translocated through xylem and phloem until it reaches the meristematic plant regions where it mimics the plant hormone auxin. Upregulation of a set of proteins responsible for gene repression and the loss of tight control of the expression of a set of genes that maintain hormonal balance result in undifferentiated cell division and elongation; however, the changes in regulation of gene expression have not been thoroughly described. Effects to plants include epinasty (downward bending of leaves), severe necrosis, stem thickening, growth stunting, leaf crinkling, calloused stems and leaf veins, leaf-cupping, and enlarged roots. These symptoms may begin a few hours to a few days after application, and plant death may occur over weeks to several months.

Proposed Use Pattern

ACP currently can be used for pre-emergent and post-emergent control of broadleaf weeds, woody species, vines, and grasses in rights-of-way (EPA Reg. No. 432-1565), including uncultivated non-agricultural areas (airports, highway, railroad and utility rights-of-way, sewage disposal areas), uncultivated agricultural areas - non-crop producing (farmyards, fuel storage areas, fence rows, non-irrigation ditch banks, barrier strips), industrial sites - outdoor (lumberyards, pipeline and tank farms), natural areas (wildlife management areas, wildlife openings, wildlife habitats, recreation areas, campgrounds, trailheads, and trails), and on native grasses and turf grasses. ACP has been registered in its acid form (PC code 288008), its methyl ester form (PC code 288009), as a potassium salt (PC code 288010) and a triethylamine salt (TEA) form (PC code 005110). The new use is being proposed for the TEA salt.

The new use for EPA Reg. No 432-1582, INVORA, is being proposed for use only in the states of Arizona, New Mexico, Oklahoma, and Texas for control of mesquite, huisache, and associated susceptible brush (woody plants) and weed species on non-hayed rangeland and non-hayed perennial grasslands managed as rangeland (including use on native and introduced perennial species). Rangelands are those lands on which the vegetation is predominantly native grasses, grass-like plants, forbs, or shrubs suitable for grazing or browsing use. Perennial grasslands are those lands on which the vegetation is dominated by grasses (native or introduced species), grass-like plants, and/or forbs suitable for grazing or browsing use. Rangelands and perennial grasslands would include grazing lands that are not currently managed or intended to be managed for hay or any other agricultural crop including annual forage grasses. Manure resulting from consumption of vegetation treated with INVORA cannot be used for compost, mulch, or mushroom spawn for a period of 2 years following application. If livestock and dairy animals graze the treatment site within 24 months following an INVORA application, livestock must be fed a diet free of ACP herbicide (or similar herbicide chemistry) for at least 3 days before transport off the property or being moved to susceptible crops.

It should be noted that this product is co-formulated with the triethylamine salt of triclopyr (PC Code 116001). Triclopyr is an auxinic herbicide known for its efficacy on woody species. This assessment only evaluates the effects of aminocyclopyrachlor.

Applications may be made by aerial, ground, or individual plant treatment (IPT) methods. The maximum single application rate for the proposed new use is 0.25 lbs a.e./A. However, huisache, western honey mesquite and mesquite are targeted at different times of the year and application rates. Huisache is treated at a maximum of 0.25 lbs a.e./A in the fall while mesquite is treated at 0.19 lbs a.e./A in the spring time; therefore, both species could not be treated in the same year. Western honey mesquite can be treated at 0.25 lbs a.e./A, although the timing is late summer/early fall. Western honey mesquite may also be treated twice at a rate of 0.14 lbs a.e./A, 14 days apart, for a total application rate of 0.28 lbs a.e./A, also in late summer/early fall. Additionally, annual rainfall is considerably higher in the more southerly huisache range than in mesquite-dominated areas. Information regarding applications to huisache and mesquite are summarized in **Table 1** below.

The INVORA label currently indicates that "a 100 ft buffer must be observed to (1) adjacent property lines, (2) free-flowing water bodies, (3) non-free-flowing water bodies not wholly located on the treatment site, and/or (4) water bodies used for irrigation purposes". While a buffer can reduce loading to areas subject to surficial water, it is uncertain as to how effective the buffer will be, as spray drift modeling indicates that effects to nontarget plants can occur out beyond 1000 feet. While the buffer may help in reducing exposure to plants beyond the rangeland's property line, it does not apply to plants in terrestrial and wetland environments located wholly on the rangeland property and will therefore not have an impact on these environments.

Environmental Fate Data

In 2015, EFED made the determination that environmental fate data for the methyl ester and acid forms of ACP could be bridged to the TEA form of ACP (DP 419688; 8/4/2015). The following discussion regarding ACP is based on the compilation of the available data. Environmental fate data are provided in **Table 2** and **Table *3*** below. Two additional terrestrial field dissipation (TFD) studies, focusing on runoff, have been reviewed since 2015 and are discussed further below.

ACP is non-volatile (3.7×10^{-8}mm Hg at 25°C and $K_H = 3.47 \times 10^{-12}$atm-m^3/mol) and highly soluble (4200 mg/L 20°C, pH 7) in water. While batch equilibrium data indicates ACP is highly mobile to mobile in the test soils (K_{oc} = 2.0 - 26 mL/g_{oc}), ACP was detected at soil depths of 70 - 90 cm at 365 days (MRID 47575102), indicating that leaching of residues into groundwater may occur. Therefore, dissipation of ACP in the environment is expected to occur predominantly via runoff and leaching.

ACP is persistent in aerobic aquatic (half-life not determined; observed DT_{50} > 100 days) and aerobic terrestrial environments ($t_{1/2}$ = 114-315 days). In addition, it is stable in anaerobic aquatic ($t_{1/2}$= 6932 days) and anaerobic terrestrial environments ($t_{1/2}$ = 1733 days). Considering abiotic degradation, ACP is stable to hydrolysis at pH 4 and 7. At pH 9, the calculated half-life is 34.7 days; however, it is uncertain if the compound degrades, because approximately 10% of the applied radioactivity decrease in the test substance coincided with approximately 10% of the applied radioactivity decrease in the material balance. Aqueous photolysis is the major route of degradation and ACP is expected to degrade with a half-life of 1.2 days in shallow, clear, and well-lit natural (pH 6.2) water bodies, and 7.8 days in pH 4 buffer solution. However, it is slowly photolyzed on soil ($t_{1/2}$= 140 days).

Ten TFD studies and one aquatic field dissipation (AFD) study from the U.S. and Canada were submitted. These studies demonstrated that ACP, in its acid form, consistently leached below the deepest sampled soil segment. Because ACP moved deeper than the sampling depth in the TFD studies, not all of the detectable mass was taken into account; thus, calculation of dissipation half-lives for comparison of studies and across formulations was not meaningful, as it would underestimate the persistence and mobility of ACP.

Two additional TFD studies (MRIDs 49614601 and 49614602), focusing on runoff from treated fields, have also been submitted. One study was conducted in Texas (MRID 49614601) and one study was done in North Carolina (MRID 49614602). In both studies, applications of ACP, as a solid granule, were made to bare soil, mowed pasture, and pasture lots. Prior to application, the plots were brought to water saturation. Approximately 5-6 hours after application, simulated rain water was applied to the treated fields and concentration measurements were made in the ensuing runoff. At the Texas site, the maximum concentrations in the run-off water ranged from 5.6 to 29.0% of the applied ACP in the various plots. At the North Carolina site, the maximum concentrations in the run-off water ranged from 8.6 to 13.4% of the applied ACP in the various plots. Residues in grass, soil, and thatch were detectable out to 15, 50, and 75 feet, respectively, in the Texas trial, pasture lots. Residues in grass, soil, and thatch were detectable out to 75, 15, and 75 feet, respectively, in the North Carolina trial, pasture lots. The extent of the studies was 75 feet. The major environmental degradates of ACP include 5-chloro-2-cyclopropyl-pyrimidin-4-ylamine, 4-cyano-2-cyclopropyl-1H-imidazole-5-carboxylic acid, cyclopropanecarboxamide, cyclopropanecarboxylic acid, cyclopropanecarboximidamide, CO_2 and formed under aqueous photolysis. Given ACP's stability in terrestrial and aquatic environments, the formation of these degradates is not expected to occur at significant levels, so ACP is considered the only residue of concern.

Table 1. Application Information for INVORA to Huisache and Mesquite

Use Site/ Location	Form[1]	App Target	App Type	App Equip	App Time	Max Single Rate lbs a.e./A	Max # App/yr[1]	Max Annual Rate lbs a.e./A/yr	MRI (d)	PHI (d)	Comments (e.g. geographic/application timing restrictions, pollinator specific language)	Drift Restrictions
Mesquite	SL	Foliage/ Plant	Broad-cast	A, G	4/15-7/15	0.19	NS	0.28	NA	NA	Apps only in AZ, NM, OK, and TX	Coarse to very coarse droplets. 100 ft buffer must be observed to (1) adjacent property lines, (2) free-flowing water bodies, (3) non-free-flowing water bodies not wholly located on the treatment site, and/or (4) water bodies used for irrigation purposes
Honey Mesquite	SL	Foliage/ Plant	Broad-cast	A, G	4/15-7/15	0.14,0.14	2	0.28	14	NA		
Western Honey Mesquite	SL	Foliage/ Plant	Broad-cast	A, G	9/1-10/31	0.25	NS	0.28	NA	NA		
Huisache	SL	Foliage/ Plant	Broad-cast	A, G	9/1-10/31	0.25	NS	0.28	NA	NA		

SL – soluble liquid, A – aerial, G- ground, NS – not specified, NA – not applicable

1. While not considered enforceable, the label does stipulate "Due to its effectiveness, INVORA™ HERBICIDE at rates of 24 to 48 fluid ounce per acre (0.13 – 0.25 pounds of the active ingredient aminocyclopyrachlor per acre) in a single broadcast application should not be applied more often than every three years".

Table 2. Physical/chemical Properties of ACP

Parameter	Value[1]			Source/Study Classification/Comment
Molecular Weight (g/mole)	213.62			--
Water Solubility Limit at 20°C (mg/L)	3130, pH 4 4200, pH 7 3870, pH 9			MRID 47559816. Acceptable.
Vapor Pressure (torr)	3.7×10^{-8} torr, 25°C			MRID 47559818. Acceptable.
Henry's Law Constant at 20°C (atm-m^3/mole)	$3.47\text{x}10^{-12}$, pH 7			MRID 47559820
Log Dissociation Constant (pKa)	4.65, 20°C			MRID 47559814. Acceptable.
Octanol-water Partition Coefficient (K_{ow}) at 25°C (unitless)	$3.31\text{x}10^{-3}$ (log K_{OW}=-2.48), pH 7			MRID 47559815. Acceptable. Not likely to bioconcentrate significantly.
Air-water Partition Coefficient (K_{AW}) (unitless)	1.10×10^{-10} (log K_{AW} = -10)			Estimated from vapor pressure and water solubility at 20°C and pH 7. Nonvolatile from water.
Soil-Water Distribution Coefficients (Kd in L/kg-soil or sediment) Organic Carbon-Normalized Distribution Coefficients (Koc in L/kg-organic carbon)	**Soil/Sediment**	**K_d**	**K_{OC}**	MRID 47560219. Acceptable. Highly Mobile to Mobile (FAO classification system); K_{OC} better predictor of sorption based on lower CV.
	Clay loam, pH 6.4	0.98	26	
	Loam, pH 8.7	0.03	5.2	
	Sandy loam, pH 8.1	0.03	2.0	
	Silty clay, pH 7.8	0.05	3.2	
	Sandy loam, pH 5.7	0.27	22	
	Mean	0.27	11.7	
	CV	150%	98%	
Fish Bioconcentration Factor (BCF) (L/kg-wet weight fish or L/kg wet weight lipid)	**Species**	**BCF**	**Depuration**	No data submitted. Not expected to bioaccumulate (K_{ow})
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Table 3. Abiotic/biotic Degradation of ACP

Study	System Details	Representative Half-life (days)[1,2]	Source/Study Classification/Comment
Abiotic Hydrolysis (50®C)	pH 4, 7 pH 9	Stable 34.7	MRID 47560210. Supplemental.
Aqueous Photolysis	pH 6.2, 20°C pH 4, 20°C 40°N sunlight	1.2 (SFO) 7.8 (SFO)	MRID 47560211. Acceptable
Soil Photolysis	CA silt loam, 20°C, pH 7.9-8.8 40°N sunlight	140	MRID 47560213. Acceptable
Aerobic Soil Metabolism	MD sandy loam, 20°C	315 (SFO)	MRID 47560214. Supplemental
	Nambesheim sandy loam, 20°C	433 (SFO)	MRID 47560221. Supplemental
	Tama silty clay, 20°C	114 (SFO)	
	Drummer clay loam, 20°C	126 (SFO)	

Study	System Details	Representative Half-life (days)[1,2]	Source/Study Classification/Comment
Anaerobic Soil Metabolism	CA silt loam, 7.9-8.8, 20°C	1733 (SFO)	MRID 47560215. Supplemental
Aerobic Aquatic Metabolism	Swiss sand, 20°C	> 100	MRID 47560216 Supplemental. No dissipation occurred up to 100 days
	UK silt loam, 20°C	> 100	
Anaerobic Aquatic Metabolism	UK silt loam, 20°C	6932 (SFO)	MRID 47560217 Acceptable. Considered stable.

Runoff and Wetland Modeling

Previous assessments (DP Barcode 353167, 1/22/2010) have evaluated the potential for exposure to aquatic systems using modeling, however, the exposure and risk profile for this new use is not expected to differ from previous conclusions, as the application rates and methods were similar to those assessed here, and is not repeated here. However, exposure to terrestrial plants adjacent to a treated field and terrestrial plants that might occur in wetlands were assessed using the Pesticide in Water Calculator (PWC v 1.52). The PWC scenario selected for modeling is the RangelandBSS scenario. This scenario was developed for an Endangered Species Assessment for the Barton Springs salamander and represents pastures, grassland, and rangeland in the Barton Springs Segment (BSS) of the Edwards Aquifer in Austin, TX. Vegetation in this habitat is generally dominated by grasses, forbs and shrubs. In the BSS, rangeland vegetation is a heterogeneous mixture of grasses (30-35%) and trees (60-65%), including ash juniper (a nuisance species), oaks, hackberry and elms. Typical grass species include little blue stem, side oats gramma, indian grass, switch grass, king ranch bluestem (introduced) and kline grass (introduced). The Brackett soil series, a common soil type of rangeland in the BSS, was selected for this scenario because it is highly representative of rangeland and pastureland areas in the BSS. As the RangelandBSS scenario is the only PWC scenario pertinent to this region and this type of use pattern, it was selected for modeling in this assessment.

The current meteorological file associated with the scenario is Austin, TX (w13958), which is designed to represent a rangeland in Southern Texas. To model a drier climate in West Texas, the RangelandBSS scenario was used with a meteorological file for Midland/Odessa, TX (w23023). Modeling in these two regions is expected to be representative of wet and dry regions in New Mexico, Oklahoma, and Arizona, where rangeland scenarios have not been developed.

Modeling was conducted for applications to remove mesquite and huisache, as these are the highest use rates on the label and are the main species being treated. Application timing for the risk assessment, based on the label and personal communications with Texas, New Mexico, Oklahoma, and Arizona State regulators and agricultural extension experts, was the following:

- Mesquite applications were modeled during three months in late spring to midsummer (4/15-7/15);
- Honey mesquite applications were modeled during three months in late spring to midsummer (4/15-7/15);
- Western honey mesquite applications were modeled during two months in the late summer and early fall (9/1-10/31);
- Huisache applications were modeled during two months in the fall (9/1-10/31).

The applications for mesquite were modeled based on a single application rate of 0.19 lbs a.e./A (0.21 kg a.e./ha). The applications for honey mesquite were modeled based on two applications at a single application rate of 0.14 lbs a.e./A (0.16 kg a.e./ha) and a minimum retreatment interval of 14 days. The applications for western honey mesquite were modeled based on a single application rate of 0.25 lbs a.e./A (0.28 kg a.e./ha). For applications to huisache, a single application rate of 0.25 lbs a.e./A (0.28 kg a.e./ha) was modeled.

The label requires that applicators "use nozzles that deliver coarse to very coarse droplets (350 to 500 microns) as defined by ASABE S572 standard". While the label specifies that "100 ft buffer must be observed to (1) adjacent property lines, (2) free-flowing water bodies, (3) non-free-flowing water bodies not wholly located on the treatment site, and/or (4) water bodies used for irrigation purposes", a buffer was not used in estimating spray drift deposition as non-target terrestrial and semi-aquatic plant exposure can still occur on the rangeland. Based on AgDRIFT (v2.1.1) Tier 1 modeling, spray drift fractions of 0.068 and 0.017 were used for aerial and ground, respectively, for PWC modeling.

While the label allows for foliar individual plant treatments, applications rates to mesquite and huisache are the highest and are the focus of this assessment.

Lastly, the label indicates that, "due to its effectiveness, INVORA™ HERBICIDE at rates of 24 to 48 fluid ounce per acre (0.13 – 0.25 pounds of the active ingredient aminocyclopyrachlor per acre) in a single broadcast application should not be applied more often than every three years". While this is not an enforceable label statement, because it states "should", it was included for characterization purposes.

Because this is a targeted risk assessment based on taxa of expected concern, the exposure analysis is focused on terrestrial plants, and modeling was conducted to evaluate exposure in terrestrial and wetland environments on and adjacent to the treated field. A more detailed description of the modeling is provided later in the document. Environmental fate and waterbody parameters used in the modeling are provided in **Table 4**. Results of the modeling are provided in **Table 5** and **Table 6**.

Preliminary runs of PWC using the application window provided in **Table 1** indicate that the 90th percentile values for the daily average value occurred on 10/9 (huisache, south), 5/7 (mesquite, south), and 7/7 (mesquite, west). These values were carried forward in the modeling results and risk assessment.

Table 4. Environmental Fate Parameters Used in Terrestrial and Wetland Modeling for ACP

Parameter (units)	Value (s)	Source	Comments
K_{OC} (mL/g)	12	MRID 47560219	Average of 5 values for parent. The coefficient of variation was 97% for K_{OC} and 150% for K_d.
Water Column Metabolism Half-life (days) at 20°C	746	MRID 47560214/ 47560221	2 x aerobic soil metabolism half-life
Benthic Metabolism Half-life (days) at 20°C	6932	MRID 47560217	Considered stable. As such, single half-life value from anaerobic aquatic metabolism study was used instead of 3x the half-life.
Aqueous Photolysis Half-life (days)@ pH 6.2	1.2 at 40°N	MRID 47560211	Representative value for parent in typical waterbodies

Parameter (units)	Value (s)	Source	Comments
Hydrolysis Half-life (days)	$1x10^{8}$	MRID 47560210	No significant degradation observed at pH 7 and 25°C. Considered stable.
Soil Half-life (days) at 20°C	373	MRIDs 47560214 and 47560221	Represents the 90 percent upper confidence bound on the mean of 4 representative half-life values from aerobic soil metabolism studies.
Foliar Half-life (days)	0	--	No Data
Molecular Weight (g/mol)	213.62	--	--
Vapor Pressure (Torr) at 25°C	3.7×10^{-8}	MRID 47559818	Vapor pressure for parent
Solubility in Water (mg/L)	4200	MRID 47559816	20°C and pH 7
Spray drift fraction	0.068 (aerial) 0.017 (ground)		EFED guidance for coarse to very coarse droplets
Application efficiency	0.95 (aerial) 0.99 (ground)		Default values assumed from Input Parameter Guidance[1]
Application rate (lb/A)	See Table 1		
Application dates	5/7 7/7 7/13 10/12 10/9		Mesquite, south Mesquite, west Honey mesquite, south Western honey mesquite, west Huisache, south
Initial/Max Depth (m)	0.15		Wetland habitat
Benthic depth (m)	0.15		Wetland habitat

1. Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/guidance-selecting-input-parameters-modeling)

Table 5. Runoff EECs for the Terrestrial Exposure Areas for the Proposed ACP Uses

Scenario	App Method	App Rate (lb a.e./A)	Terrestrial EECs (lb a.e./A)	
			Runoff only	Runoff + Drift
Mesquite, West TX	Aerial	1 x 0.19	0.0170	0.0175
	Ground		0.0052	0.0054
Mesquite, South TX	Aerial	1 x 0.19	0.0185	0.0202
	Ground		0.0059	0.0062
Honey mesquite, South TX	Aerial	2 x 0.14	0.0226	0.0244
	Ground		0.0069	0.0072
Western honey mesquite, West TX	Aerial	1 x 0.25	0.0240	0.0261
	Ground		0.0070	0.0071
Huisache, South TX	Aerial	1 x 0.25	0.0263	0.0274
	Ground		0.0073	0.0078

Table 6. Runoff EECs for the Wetland Exposure Areas for the Proposed ACP Uses

Scenario	App Method	App Rate (lb a.e./A)	Wetland EECs (lb a.e./A)
Mesquite, West TX	Aerial	1 x 0.19	0.0576
	Ground		0.0484
Mesquite, South TX	Aerial	1 x 0.19	0.0439
	Ground		0.0414
Honey mesquite, South TX	Aerial	2 x 0.14	0.0688
	Ground		0.0662
Western honey mesquite, West TX	Aerial	1 x 0.25	0.0648
	Ground		0.0561
Huisache, South TX	Aerial	1 x 0.25	0.0611
	Ground		0.0607

Compost Data and Issues

ACP is similar to a class of herbicides (picolinic acids) whose persistence in finished compost has been implicated in causing plant damage via contaminated compost. The issue of persistence in compost is being evaluated under Registration Review for other members of this chemical class including aminopyralid, clopyralid, and picloram.

There is a significant risk of compost contamination from the proposed use of ACP on pastures and rangeland from the use of treated hay as animal bedding and horse feed. Both of these materials (used bedding and manure) are commonly composted materials. Damage to nontarget plant species from contaminated compost has been reported with aminopyralid, and the extent of possible damage is expected to be similar for ACP. A submitted composting study with ACP (DP barcode D396614, April 12, 2012) showed that ACP is persistent in compost made from grass clippings and municipal yard waste. Concentrations of ACP remained above levels considered injurious to plants (by the study author) even after months of composting.

Composting facilities cannot sell their compost if it is contaminated with persistent herbicides like ACP, resulting in economic loss from profits and disposal costs. Contaminated compost can cause plant damage from concentrations of ACP that are below the level of detection. Organic farms cannot get their crops certified as organic and sell at higher prices even if the contaminated compost does not destroy the crops. Likewise, homeowners who use contaminated compost may experience damaged gardens. The US Composting Council has asked EPA to evaluate the impact of persistent herbicides including ACP in compost and consider limiting or banning specific uses that contribute to contaminated materials going into the compost stream (e.g., treated hay and feed, manure, yard waste, and other plant materials). A wide variety of stakeholders have reported that residues of persistent herbicides remaining herbicidally active in compost have caused significant damage to plants.

On the proposed label, restrictions and recommendations are included in an effort to mitigate potential risk from compost carryover. Specifically, applications are only to occur to non-hayed areas, and no hay production is permitted to occur for 2 years after application. Applications of ACP cannot be made to fields where manure is collected, and ranchers are not permitted to compost any vegetation or manure for a period of 2 years after application. Lastly, any manure must stay in the area of cleanout or be returned to the original field treated with ACP. These restrictions are thought to be sufficient to minimize concerns about contaminated compost for ACP from the proposed use.

Toxicological Effects Data

Avian Reproduction Concerns

The original ACP new chemical assessment assumed risk from chronic exposure to birds because the original avian reproduction studies were considered invalid based on guidance available at that time; however, guidance has since changed. As a result, the classification for the avian reproduction study for northern bobwhite quail (*Colinus virginianus*; MRID 47560121) was upgraded to Acceptable, and the mallard duck study (*Anas platyrhynchos*; MRID 47560122) classification was upgraded to Supplemental-qualitative. Additionally, a new mallard study (MRID 49909801; Supplemental-qualitative) was submitted, but did not derive a frank no-effect value due to weight loss at the lowest test concentration. The original mallard study did not indicate any weight loss issues, and an RQ value calculated with the lowest concentration in the new study was less than half the level of concern. Also, there was no effect on weight observed in the bobwhite quail study. Taken together, all lines of evidence suggest weight loss found in the one mallard study is not likely due to ACP. Therefore, EFED concludes ACP does not appear to have an adverse effect on avian species at environmentally relevant chronic exposures.

A 6a2 data submission, describing 'Toxicity Grades' for three species was submitted for ACP (MRID 48482601; Cited). *Trichogramma nubilale*, a predatory wasp, had a toxicity grade of 'medium risk' assigned to it while *Rana limnocharis* (a common local species of frog) and *Bombyx mori* (silk worm) were assigned a toxicity grade of 'low risk'. This study was conducted for China and is not useful for risk assessment in the US as it does not link to apical endpoints.

Plant Toxicity Data for the Proposed New Use of ACP

Incidents

There are a large number of incidents entered in the Incident Data System (IDS) for Imprelis® (EPA Reg. No. 352-793), an ACP product for use on turf that was previously cancelled. Data entry was limited by the sheer volume of incidents, so they were input to IDS as Aggregate Incidents. Mortality or 'unacceptable damage' was reported in at least 56,224 incidents, with multiple trees – mostly conifers, though several other species are reported - covered by each incident. Incident reports started in 2011, immediately after the registration of Imprelis®, and these incidents were used in a Region 3 legal action against the registrant. For the trees killed in the reported incidents, the disposal recommendation was burning or landfilling because ACP was expected to persist for too long in the material to safely mulch. All ACP turf uses were cancelled in 2011; remaining vegetative management uses were not linked to the widespread incidents.

Several other incidents are in the database from 2013-2017, including recent incidents resulting from Rights of Way uses; for example, Incident number I-031000 reports >2,100 mature ponderosa pine trees were damaged/killed across 15 miles of scenic road in the Deschutes National Forest in Oregon. This incident spurred Oregon to consider banning ACP, but instead the State implemented new restrictions as of May 2019. It should be noted that the registrant considers this incident to be a result of misuse.

OCSPP Ecological Effects Guideline Studies per 40 CFR Part 158

Following terrestrial plant toxicity study guidelines, EPA generally uses a 25% inhibition in growth, either biomass or height, to assess potential risk to plant species. A population of plants that experience ≤25% inhibition in growth early in the growing season may recover, depending on the specific species involved, but this level of effect could have lasting consequences on the affected plants because early-season growth inhibitions could result in season-long delays in growth. Additionally, adverse effects on plant reproduction have been reported for other metabolically active herbicides, but the degree to which such impacts may occur from ACP exposure has not been actively explored.

Plants whose growth is interrupted by ACP during their active growth period may not recover (e.g. MRIDs 48776902 and 48776903). Plants may be insufficiently competitive for resources, such as sunlight or water, due to their decreased growth. Early season interruptions in growth may also result in fewer absolute seed numbers or in numbers of viable seed (i.e. reproductive effects). In plant communities where ACP exposures occur, relatively insensitive species may outcompete sensitive species, leading to shifts in community composition and potentially changes in community function. Such changes may result in a cascade of ecological effects on higher order species and/or edaphic functionality (such as decreased interception of excess nutrients).

The plants used in OCSPP 40 CFR §158.660_guideline testing (850.4100 Seedling emergence; 850.4150 Vegetative vigor) are generally crop species selected specifically for their ease of husbandry in greenhouse settings. As a rule, it is best to consider each species tested as representative of a potential sensitivity in the universe of plants that may be exposed, such that, for example, the sensitivity of soybean represents not only soybean, but plants with a sensitivity similar to soybean.; however, it is not usually known what those species of similar sensitivity are. Further, the degree to which the species chosen for testing are representative of the range of potential plant sensitivities found in the general ecosystem is uncertain.

There are marked differences (i.e., greater than an order of magnitude) in seedling emergence and vegetative vigor responses between the ACP TEA salt (MRIDs 49359303 & 49359305) and the ACP methyl ester (MRIDs 47560132 & 47560133). However, subsequent comparison of the plant toxicity data for ACP acid (data submitted after the 2010 Section 3 New Chemical ecological risk assessment, MRIDs 48077801 and 48077802) indicated that the toxicity data in the TEA studies support the assertion that the proposed salt is no more toxic to plants than the currently registered forms of ACP. In the one instance where appreciably increased toxicity was initially identified for the TEA salt (soybean vegetative vigor), a comparison of the data with that from the more recently submitted ACP acid studies (MRIDs 48077801 and 48077802) indicated the data were comparable (i.e., within expected experimental variation). The toxicity endpoints for all of the studies are presented in **Table 6** below.

Additional Non-Guideline Plant Toxicity Data

The end-use product label for ACP vegetation management uses makes it clear that various woody species will be affected if exposed to ACP, with the following statement on the label: "Do not apply this product in areas where the roots of desirable trees and/or shrubs may extend. Certain species may, in particular, be sensitive to low levels of aminocyclopyrachlor including but not limited to conifers (such as Douglas fir, Norway spruce, ponderosa pine and white pine), deciduous trees (such as aspen, Chinese tallow, cottonwood, honey locust, magnolia, poplar species, redbud, silver maple, and willow species), and ornamental shrubs (such as arborvitae, burning bush, crape myrtle, forsythia, hydrangea, ice plant, magnolia, purple plum, and yew)."

Numerous other non-guideline field and greenhouse data have been submitted to evaluate the effects ACP has on trees, and impacts of potential mitigation measures (MRIDs 49335801-07). For a complete list of studies considered for this proposed use, see **Appendix A**. Most of the submitted studies are field studies, but several greenhouse studies were also conducted. Because, for the most part, auxinic herbicides such as ACP are most effective on actively growing meristem tissues, timing of applications should be considered when evaluating effects. Visual signs of phytotoxicity were used in these studies, as a practical measure, and such symptoms may be less sensitive than the growth endpoints of height and weight that are standard in the OCSPP 40 CFR 850 test guidelines. ACP symptoms from these studies included damaged needles, twisted twigs and branches (epinasty), and eventual necrosis at the higher application rates showing effects over the entire tree.

Field studies evaluated woody species responses, with white pine (*Pinus strobus*) representing the most sensitive tree species. This is not to say that white pine actually is the most sensitive woody species (other species that were not tested may actually be more sensitive), but in the areas where the studies are conducted, white pine plantings are common. MRID 49041404 also identifies slash pine (*Pinus elliotii*), long-leaf pine (*Pinus palustris*) and cottonwood (*Populus deltoides*) as very sensitive to ACP exposure. Overall, the studies mostly provide information on the distance from the trunk where applications are made and the percent effects noted, but a couple of rate-response studies provide endpoints that may be used quantitatively. The rate most frequently applied in the studies was 0.19 lbs a.e./A, the rate for targeting mesquite, but appreciably below the 0.25 lbs ae/A for huisache. Generally, ACP applications to white pine trees occurred at the candling stage, the period of most active growth. The overall signal from the field exposure studies indicates that applications within a distance from the trunk equivalent to two-thirds the height of the trees may lead to unacceptable adverse effects, with the most significant effects occuring from applications with-in the drip line of the tree. The drip line defines the distance the canopy extends away from the base of the tree.

Field response rates in white pine were estimated as part of MRID 49335801. ACP was applied to the root zone of an abandoned Christmas tree farm. This study resulted in a 25% mean visual phytotoxic impact at 0.0045 lbs a.e./A, a response rate similar to the greenhouse study described below. Other woody species in the field studies included red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*). Both species appeared less sensitive than white pine to ACP exposure, even with applications made next to the base of the trunk, though it should be noted that the timing of the applications tended to be after the early season, sensitive growth stages of these species. Similarly, in data from a greenhouse study (MRID 49335806) suggested that white pine is more sensitive than Norway spruce (*Picea abies*),though Norway spruce remains a sensitive species. Unacceptable effects (>30%, as defined by the study authors) based on visual symptoms occurred in white pine species at a rate of 0.008 lbs a.e./A and in Norway spruce at 0.033 lbs ae/A. In the study, ACP was mixed into the soil of the saplings, maximizing root contact. The resulting mean 25% effect level for white pine was 0.0025 lbs a.e./A at 90 days after treatment (DAT).

In another greenhouse study (MRID 49335805), the 90 DAT IC_{25} values (based on visual injury ratings) were estimated to be 0.0016 lbs a.e./A for white pine from foliar applications, 0.0026 lbs a.e./A for white pine from soil application, 0.0079 lbs a.i./A for honey locust (*Gleditsia triacanthos*), 0.012 lbs a.e./A for red maple and 0.054 lbs a.e./A for red oak (*Quercus rubra*) from soil applications. It is unclear whether visual symptoms of phytotoxicity are as sensitive as height or weight, endpoints which were not collected. In a concurrent soybean study, the dry weight IC_{25} value (21 DAT) was 0.0017 lbs a.e./A, which is higher than the soybean response in the three guideline studies. While the study provides usable endpoints, it is not clear that the observation period (90 DAT) fully captures the extent of effects, since it was observed in several field studies that impacts on woody species continued to accrue over time (over one year after treatment). Of particular interest in this study is the effect of ACP on red maple, which in a field study described earlier exhibited no impact from exposure to ACP. This disparity may be due to the age of the tree at exposure, the growth stage at exposure (i.e. active growth vs sugar production) or some other influence. Also, of interest from this study is that it appears white pine may be more susceptible to exposure via foliage than via root, although this point remains uncertain.

Risk Estimation and Characterizations

Currently available toxicity endpoints for ACP are reported in **Table 7**, together with distance to the LOC for each species from drift alone, via aerial application at 0.25 lbs a.e./A, the proposed single application rate for huisache. The table also includes the most sensitive IC_{25} for white pine on the basis of visual injury ratings, which may be less sensitive than impacts on height or weight. Visual phytotoxic symptoms are not typically used to calculate RQs, but in this case RQ-values are calculated for characterization of potential risk to white pine relative to other species tested. **Figures 1** and **2** present the data from the table in graphical form. Distances were determined using the AgDRIFT (v2.1.1) Tier 1 defaults, with the droplet size spectrum set to 'coarse to very coarse' based on the product label requirement. It should be noted that, because of the lower application rate for targeting mesquite, the distances for that use would be proportionally shorter.

Table 7: ACP terrestrial plant effects compilation (IC_{25}) (lbs a.e./A) and distance to the LOC (based on ASABE coarse to very coarse droplet spectra) from aerial applications at 0.25 lbs ae/A.							
	Species	TEA MRID (SE): 49359303 MRID (VV): 49359305		methyl ester MRID (SE): 47560132 MRID (VV): 47560133		ACP Acid MRID (SE): 48077801 MRID (VV): 48077802	
		IC_{25} (lbs a.e./A)	Distance to LOC (1.0)	IC_{25} (lbs a.e./A)	Distance to LOC (1.0)	IC_{25} (lbs a.e./A)	Distance to LOC (1.0)
Seedling Emergence (SE)	corn	0.388	0	0.15	0	0.27	0
	oat	0.315	0	>0.355	0	0.29	0
	onion	0.082	6.6	0.048	16	0.014	69
	ryegrass	0.028	33	0.075	6.6	0.373	0
	bean	0.002	305	0.0053	144	0.0002	>1000
	cucumber	0.123	0	0.032	26	0.036	23
	rape	0.0154	59	0.0025	253	0.0038	187
	soy	0.0132	72	0.00077	886	0.002	305
	sugarbeet	0.008	108	0.00053	>1000	0.0006	>1000
	tomato	0.006	131	0.0047	157	0.052	16
Vegetative Vigor (VV)	corn	0.109	3.3	0.096	6.6	0.056	23
	oat	0.378	0	0.16	0	0.14	0
	onion	>0.18	0	0.0058	134	0.064	10
	ryegrass	0.777	0	>0.355	00	0.273	0
	bean	0.0002	>1000	0.000075	>1000	2.25E-05	>1000
	cucumber	0.00896	95	0.00098	630	0.0015	440
	rape	0.0117	75	0.0004	>1000	0.0004	>1000
	soy	0.0002	>1000	0.00064	>1000	0.0004	>1000
	sugarbeet	0.001	613	0.00056	>1000	0.0007	>1000
	tomato	0.0009	702	0.00073	>1000	0.0003	>1000
MRID 49335805	**white pine**	**0.0016**	**410**				

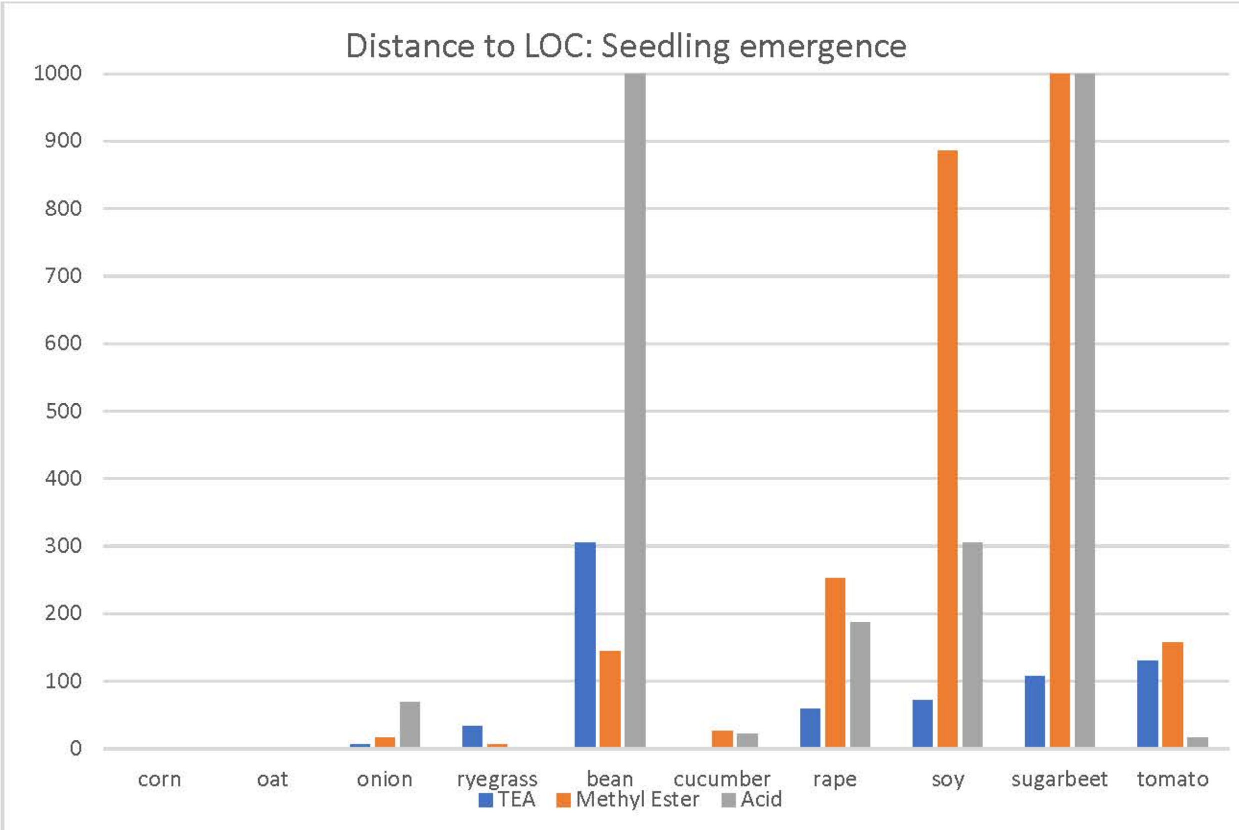

Figure 1. Distance from aerial application to the LOC for seedling emergence data.

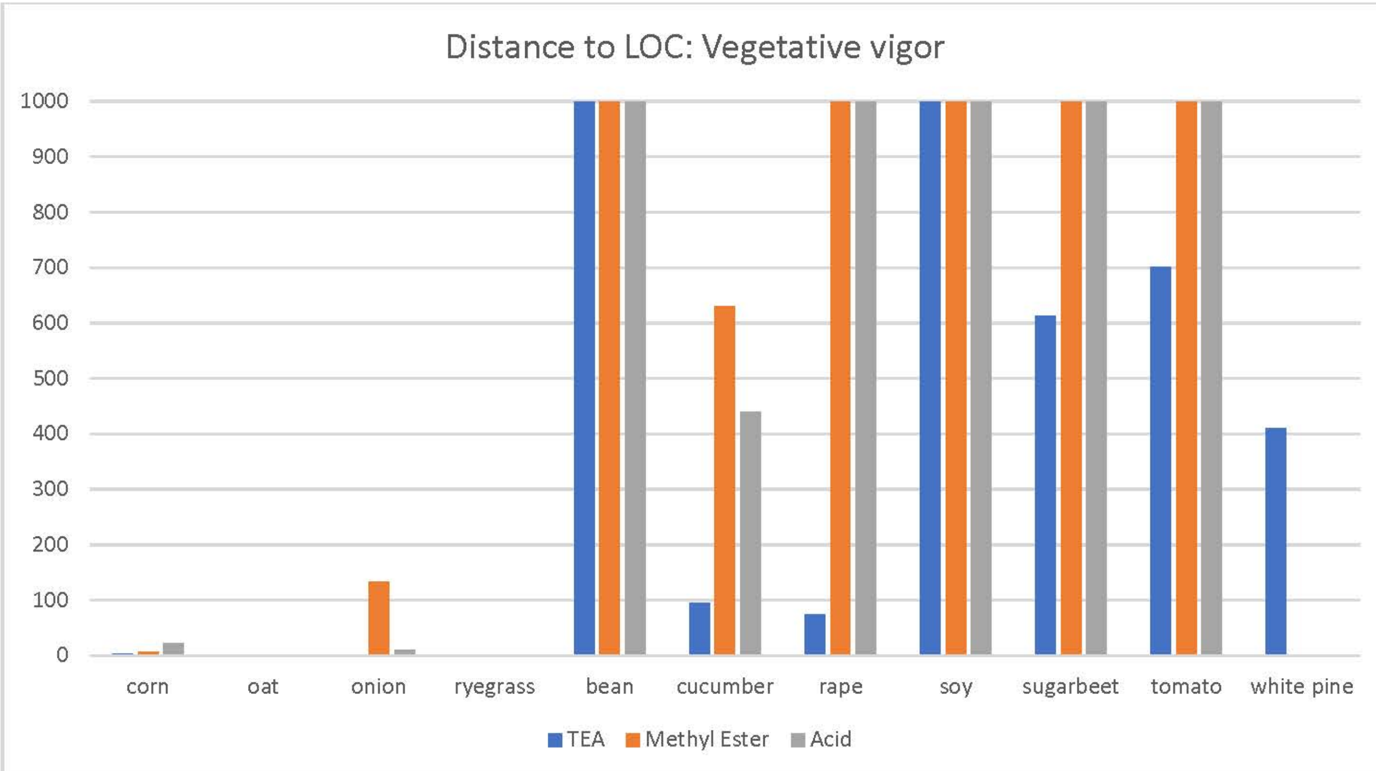

Figure 2. Distance from aerial application to the LOC for vegetative vigor data.

Runoff exposure to the root zone is thought to be a significant exposure route of concern for ACP. EFED typically employs a screening-level model known as TerrPlant, which was used in the ACP new chemical risk assessment. However, for ACP due to its well documented impact to nontarget plants, an attempt at refinement regarding runoff is presented here. The PWC model was used to provide 1-in-10 year daily average edge-of-field concentrations that were then integrated across a 30-meter terrestrial zone adjacent to the application area. A rooting depth of 15 cm is used to provide a lower bound of exposure and uses a mixing cell approach to represent water within the active root zone area of soil, and accounts for flow through the exposure zone caused by both treated field runoff and direct precipitation onto the exposure zone. Pesticide losses from the exposure zone occur from transport (i.e., washout and infiltration below the active root zone) and degradation.

Additionally, runoff to a low-lying vulnerable area, intended to represent a plant community that can exist in a saturated to flooded environment, such as a depression or shallow wetland that would collect and hold runoff from upland areas, is simulated. This adjacent wetland zone is defined as a 1 ha area receiving inputs from an adjacent 10-ha field (consistent with the conceptual model used for TerrPlant). Within the wetland zone two depth zones are defined: a standing water zone and a saturated soil pore-water (benthic) zone. The maximum depth of standing water is set to 15 cm, but water is allowed to dry down to a minimum depth of 0.5 cm. The maximum and minimum standing water depth were selected to represent a vulnerable shallow semi-aquatic area that can support a range of vegetation, including emergent vegetation. Pesticide entering the runoff area is assumed to be instantaneously distributed throughout the standing water zone. When the combination of area-normalized water inputs and existing volume in the runoff area exceed 15 cm, then flow and washout are assumed to occur, thereby removing some of the pesticide mass. Pesticide movement between the standing water and benthic zones is assumed to occur via a diffusive mass-transfer process. Within the benthic zone, pesticide sorption to sediment is also simulated. A saturated soil column depth of 15 cm was selected as the benthic zone based upon an assumed active root zone for wetland species of forbs and woody plants. Besides washout, pesticide losses from the runoff area occur through abiotic and/or biotic degradation.

Some uncertainties are associated with these exposure scenarios. For instance, the amount of ACP actually available for runoff is uncertain. ACP is applied foliarly, absorbed by the plant and is transported into the plant vasculature and cellular structures. As discussed previously, ACP is known to be sequestered in plant material and persist there, hence the concerns for composting of treated material. Therefore, the amount of material remaining available for runoff events may be less than what is initially applied to plants. However, studies are available that explore runoff from grasslands. Considering the PWC runs, the maximum daily runoff ranged from 0.002 to 11.1%, with a 1-in-10 year value of 6.9%. Looking at the TFD study for Mertens, TX (MRID 49614601), runoff estimates ranged from 5.6 to 29% on pasture land that was applied in August, suggesting model estimates may be on the low-end when compared to the pastures in the TFDs. However, it should be noted that the plots in the TFD were pre-irrigated to at or near steady state runoff, so the soils were generally saturated. Range and pasture sites located in Texas that will be typically treated with ACP are not likely to be irrigated to saturation prior to application of ACP, so the runoff from the TFD studies is expected to be higher than what should result from this new use.

As described previously, five application scenarios were modeled for runoff estimates: one representing mesquite applications in the western, drier, part of the proposed use area (mesquite west); one representing mesquite applications in the southeastern, wetter, part of the proposed use area (mesquite south); one representing two honey mesquite applications in the southeastern, wetter, part of the proposed use area (honey mesquite south); one representing a honey mesquite application in the western, drier, part of the proposed use area (western honey mesquite); and a final scenario representing huisache (huisache south), also in the southeastern portion of the proposed range.

Runoff RQs for the far edge of the terrestrial zone, which include a drift component utilizing AgDRIFT, are presented in **Tables 8** and **9**. RQs are based on endpoints from studies conducted with ACP acid, which are considered representative for this assessment. However, the endpoint for white pine is taken from a greenhouse study discussed previously. In general, as expected based on ACP's mode of action, the vegetative vigor growth stage is considerably more sensitive than the seedling emergence growth stage. The highest RQ for vegetative vigor is for bean, with an RQ of 1,218 based on the huisache south scenario. The grasses tested are largely unimpacted by exposure to ACP.

The huisache south scenario results in vegetative vigor RQs that are 1-2X higher than RQs from the mesquite north and south scenarios. This is not unexpected for at least two reasons. First, the application rate for the huisache use is 0.25 lbs ae/A while generally the mesquite rate is 0.19 lbs ae/A. Additionally, since these are runoff RQs, greater nontarget exposure is expected in areas with higher rainfall amounts. The western honey mesquite was analyzed separately as it is treated at the higher rate like huisache, but at a different time of year than the other species.

Additionally, it should be noted that the highest RQ-value for white pine is 17, which exceeds the LOC of 1.0. RQ-values for white pine are higher than those for corn, oat, onion and ryegrass (RQs ≤0.3), and also cucumber (RQs ≤6.9), but are 2.2-4X lower than RQs for rapeseed, soy, sugarbeet, and tomato, and roughly 70X lower than RQs for beans. Again, the endpoint for white pine is based on visual signs of damage, which are generally not as sensitive as the growth endpoints typically assessed. However, it is of appreciable interest that, despite vegetative vigor RQs of 11-17, white pine (and other pine species) are typically one of the most impacted species based on the incidents discussed earlier.

Table 8. Runoff RQs for the terrestrial zone for seedling emergence endpoints.

	Seedling Emergence				
	mesquite west	mesquite south	huisache south	western honey mesquite south	western honey mesquite west
corn	0.1	0.1	0.1	0.1	0.1
oat	0.1	0.1	0.1	0.1	0.1
onion	1.2	1.3	2	1.6	1.7
ryegrass	<0.01	<0.01	0.1	0.1	0.1
bean	85	92	137	113	120
cucumber	0.5	0.5	0.8	0.6	0.7
rape	4.5	4.9	7.2	6.0	6.3
soy	8.5	9.2	14	11	12
sugarbeet	28	31	46	38	40
tomato	0.3	0.4	0.5	0.4	0.5

Table 9. Runoff RQs for the terrestrial zone for vegetative vigor endpoints.

	Vegetative Vigor				
	mesquite west	mesquite south	huisache south	western honey mesquite south	western honey mesquite west
corn	0.3	0.3	0.5	0.4	0.4
oat	0.1	0.1	0.2	0.2	0.2
onion	0.3	0.3	0.4	0.4	0.4
ryegrass	0.1	0.1	0.1	0.1	0.1
bean	755	820	1218	1006	1065
cucumber	4.2	4.6	6.9	5.7	6.0
rape	42	46	68	57	60
soy	42	46	68	57	60
sugarbeet	24	26	39	32	34
tomato	57	62	91	75	80
white pine	11	12	17	14	15

RQs for wetlands or other low-lying vulnerable areas follow a similar pattern to that seen with the terrestrial exposure area, but overall wetland RQs are 2-4X higher than terrestrial exposure RQs, as runoff from a larger area is aggregated in a confined area (**Tables 10** and **11**). Again, huisache south results in higher RQs than mesquite, but western honey mesquite results in the highest RQs. The western honey mesquite RQ based on the endpoint for beans exceeds 3,000; for additional comparison, the white pine RQ is 38 (white pine is associated with many of the reported incidents). One other point to note is that in the wetland exposure area in the huisache south scenario and both honey mesquite scenarios, the RQ for corn (a grass; Poaceae) actually exceeds the LOC suggesting that some grass species in wetland areas may be impacted to some extent.

Table 10. Runoff RQs for the wetland zone for seedling emergence endpoints.

	Seedling Emergence				
	mesquite west	mesquite south	huisache south	western honey mesquite south	western honey mesquite west
corn	0.3	0.2	0.3	0.3	0.3
oat	0.2	0.2	0.2	0.2	0.2
onion	4.1	3.1	4.4	4.9	4.6
ryegrass	0.2	0.1	0.2	0.2	0.2
bean	288	220	305	344	324
cucumber	1.6	1.2	1.7	1.9	1.8
rape	15	12	16	18	17
soy	29	22	30	34	32
sugarbeet	96	73	102	115	108
tomato	1.1	0.8	1.2	1.3	1.2

Table 11. Runoff RQs for the wetland zone for vegetative vigor endpoints.

	Vegetative Vigor				
	mesquite west	mesquite south	huisache south	western honey mesquite south	western honey mesquite west
corn	1	0.8	1.1	1.2	1.2
oat	0.4	0.3	0.4	0.5	0.5
onion	0.9	0.7	1	1.1	1.0
ryegrass	0.2	0.2	0.2	0.3	0.2
bean	2559	1952	2715	3056	2880
cucumber	14	11	15	17	16
rape	144	110	153	172	162
soy	144	110	153	172	162
sugarbeet	82	63	87	98	93
tomato	192	146	204	229	216
white pine	36	27	38	43	40

Different taxa result in different RQs, each representing a level of sensitivity to ACP as determined by dose-response studies. Based on the results from bean, some plants are expected to be particularly impacted by runoff, while other species, such as grasses, may not be affected at all from ACP exposure.

Ecosystem Effects

In addition to direct adverse effects on plant species that are likely to result from the proposed ACP uses, plant biodiversity provides a number of ecosystem services, including providing habitat for pollinators and beneficial insect predators, that will indirectly be adversely affected. Recently, a great deal of research has been directed at the effect of plant diversity and associated insect populations (Freemark and Boutine, 1995; Isaacs *et al.* 2009; Mortensen et al., 2012. Norris and Kogan, 2000; Norris and Kogan, 2005). Similar disruptions in habitat or food sources may occur for higher order animals (e.g. birds and mammals) on use sites and areas near them. As changes in plant communities occur due to differences in species sensitivity, subsequent loss of preferred feed or shelter for animals could occur. In this way, animals can be affected by use of ACP. Affected animals might be at any trophic level, and may particularly affect organisms with obligate relationships to specific plant species. It is important to recognize that adverse impacts to wildlife habitat may occur and that care should be taken by the landowner to protect areas of their property intended for wildlife from ACP exposure.

The proposed new use is mainly directed at control of huisache and mesquite, although control of other brush species is also anticipated. These other brush species include, according an early draft of the label, common and Texas persimmon (*Diospyros virginiana* and *D. texana*), flame leaf sumac (aka winged sumac; *Rhus copallinum*), yaupon (a type of holly; *Ilex vomitoria*) and Texas mountain laurel (*Sophora secundiflora*). These species are native to the area and are an important part of wildlife habitat. These species are mid-successional plants, and if allowed to grow unhindered would eventually contribute to transformation of the grasslands into forest.

Additionally, the negative impact of ACP use on forbs, often important forage for wildlife, is expected to be appreciable. However, the loss of most forbs is also expected to be temporary. In a 2019 registrant submission entitled "Invora™ Herbicide: Species Diversity Report" (MRID 51017401), recovery of species diversity in treated application sites over a one- to seven-year period was documented. Although limited in scope, these data indicate that in the years following treatment, plant species community composition changes in terms of percent cover. In the treated areas, the most common forbs were *Ruelllia nudiflora* (violet petunia), *Marsilea macropoda* (water-clover), *Tradescantia micrantha* (little-flower spiderwort), *Lythrum californicum* (California loosestrife), and *Commelina erecta* (dayflower). In the untreated plots, the most common forbs were *Coreopsis tinctoria* (tickseed), violet petunia, *Ambrosia cumanensis* (ragweed), *Desmanthus virgatus* (bundleflower), and California loosestrife. It is important to note these species compositional changes may impact wildlife that have specific forage or host plant preferences. It is also unclear what the wildlife would do in the intervening years. However, if used as intended, only a part of any given rangeland area would be treated in any given year, meaning that wildlife should have the opportunity to move to untreated areas.

Overall Conclusions

Given the mobility and persistence of ACP, modeling has indicated that there is the potential for runoff from an area, treated at the proposed application rates, which will adversely affect surrounding nontarget vegetation. Additional impacts are expected from off-target spray drift. Requirements intended to ensure that ACP does not end up in compost and adversely affect any plants that may be supplemented with compost or manure are included on the label. However, impacts to the nontarget vegetation may have a persistent effect on ecosystem function.

Uncertainties and Limitations in the Plant Risk Assessment

Exposure pathways: it is unclear what the exact route of exposure was that caused the known incidents for ACP, although the Registrant has postulated runoff exposure. Field studies do suggest that runoff from the target area can cause adverse effects to sensitive species.

There is also a considerable level of uncertainty in the modeling of spray drift and runoff exposure routes. Spray drift deposition can be estimated in feet off the treated area using the AgDRIFT model. Runoff EECs cannot be characterized by specific distance off the field, but rather by the types of runoff that can be occurring. Sheet flow runoff is generally limited to immediately adjacent to the field, but runoff characterized by channelized flow can move an unknown distance for the site of application.

There is also uncertainty in the modeling scenario that was used. It is uncertain how representative the BSS Range scenario is for use in Arizona, New Mexico, and Oklahoma, where the registration is also being proposed.

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Appendix A: Studies Reviewed for This Assessment

DP Barcode	CETIS flag[a]	MRID	Guideline	Taxon	Classification	Comments
Effects Studies						
419472	NA	49335801	None	Various	Supplemental	This MRID summarizes several of the studies included in this list. They are therefore summarized in this DER.
419472	NA	49335802	None	White pine (*Pinus strobus*)	Supplemental	See DER for 49335801
419472	NA	49335803	None	White pine	Supplemental	See DER for 49335801
419472	NA	49335804	None	White pine	Supplemental	See DER for 49335801
419472	NA	49335805	None	Various	Supplemental	See DER for 49335801
419472	NA	49335806	None	White pine and Norway spruce (*Picea abies*)	Supplemental	See DER for 49335801
419472	NA	49335807	None	White pine	Supplemental	See DER for 49335801
408979	NA	49041401	None		Cited	No DER
408979	NA	49041402	None		Cited	No DER
408979	NA	49041403	None		Cited	No DER
408979	NA	49041404	None		Cited	No DER
408979	NA	49041405	None		Cited	No DER
450760	NA	48482601	None	Three Chinese species	Cited	No DER; data do not support risk assessment; Submitted under 6a2
Fate Studies						
	NA	48333628	None	NA	Acceptable	Storage stability study on grass forage and hay
413895	NA	49168001	None	NA	Acceptable	Storage stability study on soil
491688/ 427249	NA	49359301/ 49614601	835.6100	NA	Supplemental	Application rates were 71% of the nominal rates and the stability of ACP and its degradates were not adequately

						determined in frozen soil
491688/ 427249	NA	49359302/ 49614602	835.6100	NA	Supplemental	Stability of ACP and its degradates were not adequately determined in frozen soil
421254/ 428162	NA	49409801/ 49656901	835.6100	NA	Supplemental	Stability of ACP and its degradates were not adequately determined in frozen soil, grass, or thatch
421254/ 428162	NA	49409802/ 49656902	835.6100	NA	Supplemental	Stability of ACP and its degradates were not adequately determined in frozen soil, grass, or thatch
421254	NA	49409804	Nonguideline	NA	Not acceptable	Recovery at time 0 was <90% of the applied. The application rate was not confirmed. Replicate data were not reported. Analytical methods were not reported.